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Development of motor control

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SUMMARY

The aim of this thesis is to study the role and efficiency of motor control and anticipation processes in the development of children with and without disturbances in the motor system.

Chapter I is a general introduction to the subject of this thesis. In the first part of this chapter the rationale for extending knowledge in the field of motor development is given. Generally, it is found that motor development and disturbances in the motor system are manifest in the speed and accuracy of goal directed movements. The question is what processes determine speed and accuracy of such responses, and how they contribute to the ontogeny of skilled motor performance? In the second part of this chapter the general aim and the contents are described.

Chapter II is a selective survey of developmental theories and data relevant to the ontogeny of motor control and coordination. Organismic theories describe development as a process of differentiation and integration of abilities determined by the interaction between genetical and experiential factors. During development, children learn not only the invariant features of objects and situations, but also the properties of the neuromuscular system. This process is characterized by an increasing attunement to task situations. Information theories describe development as the improvement of information processing capacity. This is reflected by the increase in speed and accuracy of movements. It is hypothesized that improving attunement of motor actions to task situations is reflected in the increasing ability to preprogram movements accurately according to task demands, even in time pressure conditions. This may account for the increasing speed and accuracy of responses with development.

Chapter III is dedicated to the existing literature on the field of motor control and anticipation processes relevant to the performance of goal directed movements. Motor control theories distinguish roughly two types of movements, namely continuous or open-loop controlled movements and discontinuous or closed-loop controlled movements. The former type is determined completely by the initial impulse. This is preprogrammed and accurately attuned to the target. However, when on the basis of feedback monitoring it is established that the initial impulse does not fit the task demands and the movement does not arrive at the target, the initial impulse is succeeded by one or more corrective impulses. Such corrective impulses appear as discontinuities in the velocity-time signal of the discontinuous movement nearby the target. Extra force impulses lengthen the duration of the movement. The ability to predict the outcomes of neuromuscular activities is called "effector anticipation". Successful effector anticipation is reflected by an accurate attunement of the preprogrammed initial impulse and the absence of corrective impulses nearby the target. In such continuous movements peripheral feedback becomes redundant. The control of continuous movements spares the processing capacity of the sensori-motor system. Accurate effector anticipation allows visual "receptor anticipation" during the execution of movements. This means that information with respect to succeeding motor activities in a sequence of goal directed movements can be perceived and processed in advance. Successful receptor anticipation shortens the latencies between succeeding movements.

Chapter IV deals with the experimental study of motor control processes and effector anticipation in simple goal directed movements of 5-9 year old children and adults. They carried out a reciprocal tapping task, in which time pressure and movement complexity was manipulated following Fitts' law by

